www.metrel.si 2008

HV INSULATION DIAGNOSTICS

METREL®

TeraOhm 10 kV
TeraOhm 5 kV Plus
TeraOhm 5 kV
GigaOhm 5 kV
ISOTest

TeraOhm 10 kV MI 3200

Profesional diagnostic insulation tester

TeraOhm 10 kV is a professional high voltage insulation tester with included diagnostics tools.

It is specially well suited for:
- testing insulation resistance of rotating machinery and cables
- production line periodic testing and maintenance
- troubleshoting and analysis of all kinds of insulation problems
- insulation testing of power transformers
- insulation resistance measurements of measuring transducers in distribution networks

Because of its robustness (CAT IV protection) it is best suited for industrial environment.

Main features:
- Insulation resistance measuring range up to 10 TΩ
- DC test voltage from 500 V up to 10.000 V adjustable in 25 V steps
- Powerful diagnostics tools include PI, DAR and DD measurements
- Step voltage insulation test
- MAX charging current is 5 mA
- Automatic discharge of capacitive loads
- Digital bar graph presentation of result with date and time stamp
- RS232 and USB communication ports
- Windows compatible PC Software TeraLink
- High quality accessories with shielded test leads included in a standard set
- High level of EM (noise) protection
- CAT IV/600 V over-voltage category for industrial and power distribution applications
- Powered either by mains voltage or rechargeable batteries

Powerful features of diagnostic tests:
- Discharge current, voltage and capacitance measured on the equipment under test
- Polarization index (PI) calculation
- Dielectric absorption ratio (DAR) calculation in first minute
- Dielectric discharge ratio (DD) calculation.

Typical applications:
- power transformers
- high voltage cables
- rotating machines
- surge arrestors
- measuring transducers

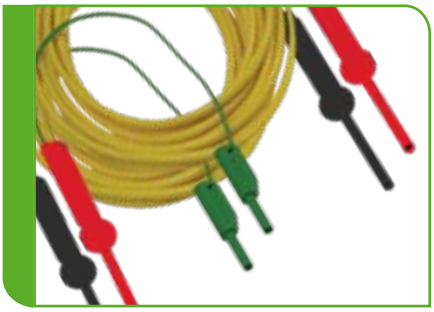
Standards applied:
Instruments: EN61557-2, EN61326, EN61010-1, EN61010-31
Applications: EN60345, EN61010, IEEE43:2000

Technical Specification

Measuring range:	0.12 MΩ ÷ 10 TΩ	Acc. ±(5 % of r. + 3 dig.)
Test voltage ranges (DC):	500 V ÷ 10000 V in steps of 25 V	Acc. ±(3 % of r. + 3 V)
Bar graph trend:	0 ÷ 1 TΩ	
Withstanding test voltage:	500 ÷ 10000 V	Acc. ±(3 % of r. + 40 V)
Leakage current range:	0 ÷ 5 mA	Acc. ±(3 % of r. + 3 dig.)
Voltage AC/DC range:	0 ÷ 600 V	Acc. ±(3 % of r. + 4 V)
Capacitance range:	0 ÷ 50 µF	Acc. ±(5 % of r. + 2 dig.)
Polarization index (PI) range:	0 ÷ 99.9	Acc. ±(5 % of r. + 2 dig.)
Dielectric discharge test (DD) range:	0 ÷ 99.9	Acc. ±(5 % of r. + 2 dig.)
Dielectric absorption ratio (DAR) range:	0 ÷ 99.9	Acc. ±(5 % of r. + 2 dig.)
Step voltage:	500 ÷ 10000 V in five steps	

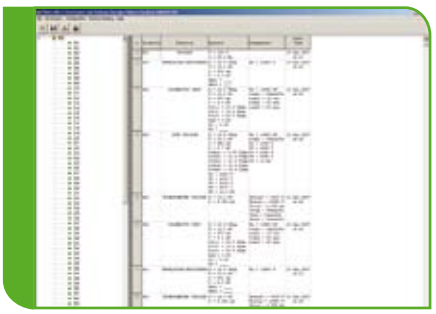
General	
Battery power supply:	7.2 V DC (6 x 1.2 V NiMH, IEC LR20, D size)
Mains power supply:	90 - 260 V AC, 45-65 Hz
Protection classification:	Double insulation
Over-voltage category:	CAT IV/600 V
Pollution degree:	2
Degree of protection:	IP 44 with case closed
Dimensions (w × h × d):	360 x 160 x 330 mm
Weight:	5.5 kg (with batteries,without accessories)
Visual and sound warnings:	Yes
Display:	LCD dot matrix with backlight (160 x 116)
Memory:	Non-volatile internal memory, 1000 measurements with time and date
Working temperature range:	-10 ÷ 50 °C
Nominal temperature range:	10 ÷ 30 °C
Storage temperature range:	-20 ÷ 70 °C
Maximum humidity:	95 % RH (0 ÷ 40 °C) non-condensing
Nominal humidity range:	40 ÷ 60 % RH

Key features



Shielded test leads for use in environments with high EM interferences (open HV switchyards) for improved accuracy of the test results.

Mains power supply with built-in battery charger for NiMH batteries.
RS232 and USB communication ports.



Windows compatible PC Software TeraLink for downloading and management of recorded test data.

Use of a "Guard" terminal eliminates an influence of surface insulation currents on the measuring result. To assure high accuracy of the measuring results a "Guard" terminal is to be used in conjunction with shielded test leads when measuring insulation resistances in GΩ or TΩ range.

Testing with TeraOhm on 400 kV switchyard in Divača
Insulation diagnostics with Metrel TeraOhm MI 3200 in 400 kV switchyard had dictated a use of shielded test leads to avoid influence of strong external EM fields on the measuring result.

Ordering information

Standard set **MI 3200**

Instrument TeraOhm 10 kV
Mains cable
10 kV shielded test lead with tip, 2 m
10 kV shielded test lead set, 2 m (black, red)
10 kV alligator set (black, red)
Guard test lead 2 m with alligator clip (green)
6 x 1.2 V NiMH batteries, Type D
Handbook "Guide to moderen insulation testing" on CD
Instruction manual
Product verification data

TeraOhm 5 kV Plus MI 3201

The new TeraOhm 5kV insulation tester has all necessary features for a profound insulation diagnostics. Automated calculation of PI, DD and DAR, combined with a possibility to perform a step voltage test make the instrument suitable for the most demanding customers and applications.

Main features:
- Resistance measuring range up to 10 TΩ
- Test voltage from 250 V to 5 kV adjustable in 25 V steps
- Powerful insulation diagnostics tools include PI, DAR and DD measurements
- Step voltage test with five discrete test voltages proportionally set within a preset test voltage range
- On-Line R(t) graph plotting facility
- 5mA charging current
- Automatic discharge of tested object after the measurement is completed
- Capacitance measurement up to 50 µF

Highlights:
- High level of EM (noise protection) including built-in EM filters and shielded test leads delivered in standard set
- Programmable timer
- Withstanding test with programmable insulation leakage current up to 5 mA
- Professional Windows compatible PC Software TeraLink PRO with a graph plotting facility as option
- Mains or rechargeable battery power supply

Typical applications:
- power transformers
- high voltage cables
- rotating machines
- surge arrestors
- measuring transducers

Standards applied:
Instruments operation: IEC/EN61557-2
Electromagnetic compatibility: EN 61326 class B
Safety: EN 61010-1 (instrument), EN 61010-031(accessories)

Technical Specification

Insulation resistance:	0.12 MΩ ÷ 10 TΩ
Test voltage (DC):	up to 5kV adjustable in 25V steps
Programmable timer:	1 s up to 30 min (IR)
Current range:	0 ÷ 5.5 mA
Dielectric absorption ratio (DAR):	0 ÷ 99.9
Polarization index (PI):	0 ÷ 99.9
Dielectric discharge test (DD):	0 ÷ 99.9
Step voltage (SV):	up to 5 kV in five steps
Capacitance:	up to 50 µF
Withstanding voltage (DC):	0 ÷ 5000 V
Voltage:	0 ÷ 600 V AC/DC

General	
Battery power supply:	7.2 V DC (6 × 1.2V NiMH IEC LR14)
Mains power supply:	90 ÷ 260 V AC, 45 ÷ 65 Hz, 60 VA (CAT III, 300 V)
Protection classification:	double insulation
Overvoltage category:	CAT IV/600 V
Pollution degree:	2
Degree of protection:	IP 44 with case closed
Dimensions (w × h × d):	310 x 130 x 250 mm
Weight (with batteries):	3 kg
Visual and sound warnings:	yes
Display:	LCD dot matrix with backlight (160 x 116)
Memory:	Non-volatile internal memory, stores up to 1000 measurements

Key Features

Handle and shoulder strap make the unit easy to carry.

Real time R=f(t) graph plotting facility.

USB and RS232 COM ports for connecting the instrument to the PC.

Guard connection terminal to eliminate the influence of surface insulation currents.

Recommended procedure for testing of insulation with DC high voltage

Professional and user friendly insulation testing

TeraOhm 5 kV Plus
packed with numerous features for complete insulation diagnostics

Inregrated memory module stores up to 1000 test results

Windows compatible TeraLink PRO PC Software for test data management enables R=f(t) graph plotting

USB and RS 232 COM ports for downloading

Ordering information

Standard set **MI 3201**

Instrument TeraOhm 5 kV Plus
Carrying bag
Mains cable
10 kV shielded test lead set, 2 m (black, red)
10 kV alligator set, (black, red)
Test lead with alligator clip, 2 m (green)
6 x 1.2 V NiMH batteries, C type
Handbook "Guide to modern insulation testing" on CD
Instruction manual
Product verification data

TeraOhm 5 kV MI 2077

Advanced, field proven instrument. Technical demands require high performance measuring instruments capable of measuring polarization index (PI), dielectric absorption ratio (DAR), dielectric discharge (DD), insulation system capacitance. Easiness of use, high EM immunity and automatic discharge of load after completed measurement are just some of many outstanding features that distinguish Metrel HV testers from other similar products on the market.

High insulation resistance measurement:
- DC test voltages 250 V ÷ 5000 V in steps of 50 V
- Measuring range up to 5 TΩ
- Timer mode from 1 s up to 30 min
- Capacitance measurement up to 50 μF

Step voltage measurement of insulation resistance:
- DC test voltage up to 5000 V automatically divided in 5 steps
- Adjustable test time

Withstanding voltage test up to 5000 V:
- Insulation leakage current measurement
- Adjustable test voltage slope
- Pre-set threshold test current from 1 mA to 1.4 mA
- Time programmable step voltage test

Other features:
- Voltage and frequency measurement up to 600 V AC/DC
- Automatic discharge of capacitive loads
- Guard terminal to eliminate influence of insulation surface leakage currents
- Digital and bar graph display
- Built-in battery charger
- User-friendly PC software (optional)
- RS232 isolated communication port

Typical applications:
- Rotating machines
- Transformers
- Cables
- High voltage generators
- Electrical circuits
- Surge arresters
- Measuring transducers

Standards applied:
- Instruments operation: IEC/EN 61557-2
- Electromagnetic compatibility: (EMC) EN 61326 Class B
- Safety: EN 61010-1 (instruments), EN 61010-031 (accessories)

Technical Specification

Measuring range:	0.12 MΩ ÷ 5 TΩ	Acc. ±(5 % of r. + 3 dig.)
Test voltage ranges (DC):	250 V ÷ 5000 V in steps of 50 V	Acc. ±(3 % of r. + 3 V)
Bar Graph Trend:	0 ÷ 1 TΩ	
Withstanding test voltage:	0 ÷ 5000 V	Acc. ±(3 % of r. + 40 V)
Leakage current range:	0 ÷ 1,4 mA	Acc. ±(3 % of r. + 3 dig.)
Voltage AC/DC range:	0 ÷ 600 V	Acc. ±(3 % of r. + 3 V)
Capacitance range:	0 ÷ 50 μF	Acc. ±(5 % of r. + 2 dig.)
Polarization index (PI) range:	0 ÷ 99.9	Acc. ±(5 % of r. + 2 dig.)
Dielectric discharge test (DD) range:	0 ÷ 99.9	Acc. ±(5 % of r. + 2 dig.)
Dielectric absorption ratio (DAR) range:	0 ÷ 99.9	Acc. ±(5 % of r. + 2 dig.)
Step voltage:	250 ÷ 5000 V in five steps	

General	
Battery power supply:	7.2 V DC (6 x 1.2 V NiMH batteries, IEC LR14)
Mains power supply:	230 V AC, 45-65 Hz
Protection classification:	Double insulation
Over-voltage category:	CAT III/600V
Pollution degree:	2
Degree of protection:	IP 44
Dimensions (w × h × d):	265 x 110 x 185 mm
Weight (with batteries):	2.3 kg
Visual and sound warnings:	Yes
Display:	LCD dot matrix with backlight (160 x 116)
Memory:	Non-volatile internal memory, 1000 measurements
Working temperature range:	-10 ÷ 50 °C
Nominal temperature range:	10 ÷ 30 °C
Storage temperature range:	-20 ÷ 70 °C
Maximum humidity:	95 % RH (0 ÷ 40 °C) non-condensing
Nominal humidity range:	40 ÷ 60 % RH

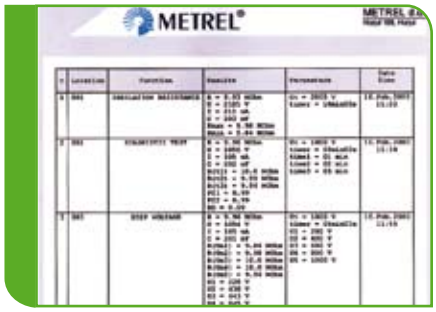
Key features

Large custom LCD dot matrix display with bar graph and backlit. Simultaneous presentation of measuring results and test parameters. Built- in timer and real time clock.

User friendly keyboard enables simple and fast adjustment.

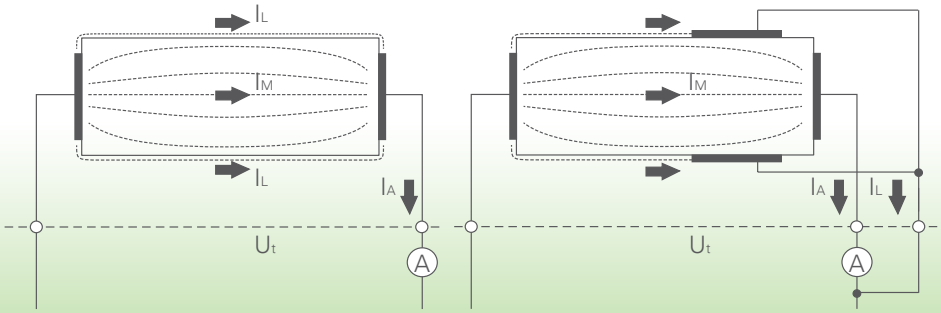
Guard connection terminal to eliminate the influence of surface insulation currents.

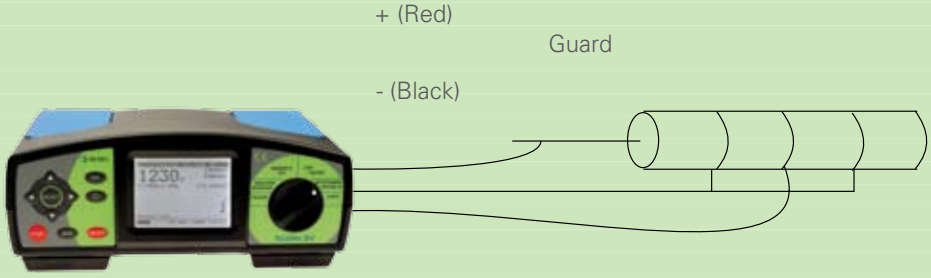
230 V power supply with built-in battery charger for NiMH batteries enables measurement during the charging. 110 V power supply available on request.



Up to 1000 test results can be stored in the memory module of TeraOhm 5kV. Windows compatible TeraLink PC software serves for downloading and management of test results. Results can be further exported to other Windows programs.

Use of a "Guard" terminal eliminates an influence of surface insulation currents on the measuring result. To assure high accuracy of the measuring results a "Guard" terminal is to be used in conjunction with shielded test leads when measuring insulation resistances in GΩ or TΩ range.





Ordering information

Standard set **MI 2077**

Instrument TeraOhm 5 kV
Soft carrying bag
Mains cable
Test lead set, 2 m (black, red)
Guard test lead 2 m with alligator clip (green)
Alligator clips, 2 pcs (black)
Handbook "Guide to modern insulation testing" on CD
Instruction manual
Product verification data

GigaOhm 5 kV MI 3202

GigaOhm 5kV is a high quality insulation and voltage tester with excellent price-performance ratio. Five test voltages up to 5 kV and 1 TΩ resistance measuring range cover most of the industrial and power distribution applications.

Shielded test leads for improved EM immunity and high measuring accuracy are included in the standard set. User friendly design is completed with a large LCD display. A rugged carrying case provides mechanical robustness needed at the use in harsh environments.

Main Features:
- Insulation resistance up to 1TΩ
- Test voltage 250 V, 500 V, 1 kV, 2.5 kV and 5 kV
- Pass/Fail indication after auto-calibration is completed
- Automatic Discharge of test object every time after measurement is completed
- Guard terminal to eliminate surface leakage current
- Mains and rechargeable battery power supply
- High quality accessories

Typical applications:
- rotating machines
- transformers
- cables
- generators
- surge arrestors
- measuring transducers

Standards:
Instruments operation:
IEC/EN61557-2
Electromagnetic compatibility:
EN 61326 class B
Safety:
EN 61010-1 (instrument)
EN 61010-031(accessories)

Technical Specification

Insulation resistance:	0.12 MΩ ÷1 TΩ
Voltage:	0 ÷ 600 V AC/DC
Test voltage (DC):	250 V, 500 V, 1 kV, 2.5 kV, 5 kV
Current range:	0 ÷ 5 mA

General	
Battery power supply:	7.2 V DC (6 x 1.2 V NiMH IEC LR14)
Mains power supply:	90-260 V AC, 45-65 Hz
Protection classification:	Double insulation
Over-voltage category:	CAT IV/600 V
Dimensions (w × h × d):	310 x 130 x 250 mm
Weight (with batteries):	3 kg
Display:	LCD segments with backlight

Key features

Handle and shoulder strap make the unit easy to carry.

Large LCD display with backlit.

User friendly front plate for quick test adjustment.

Short user manual for quick access to the measuring setup is packed inside the instrument.

Mains and rechargeable battery power supply.

Guard connection terminal to eliminate the influence of surface insulation currents.

Ordering information

Standard set **MI 3202**

Instrument GigaOhm 5 kV
Carrying bag
Mains cable
10 kV shielded test lead set, 2 m (black, red)
10 kV alligator set, (black, red)
Guard test lead with alligator clip, 2 m (green)
6 x 1.2 V NiMH batteries, C type
Handbook "Guide to modern insulation testing" on CD
Instruction manual
Product verification data

ISO test MA 2060

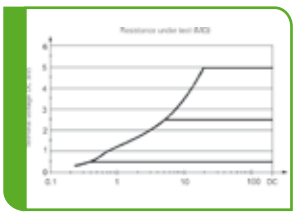
Analogue High Voltage Insulation Tester

ISOTest is a field proven high voltage insulation tester. Built-in in a rugged carry case it is best suited for harsh industrial environments. ISOTest has an analogue scale and a necessary GUARD connection terminal to eliminate insulation surface currents.

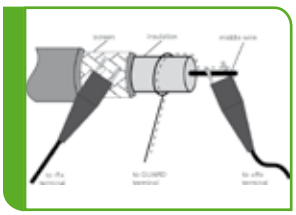
Features:
- AC and DC voltage measurement up to 600 V
- Four measuring ranges 500 V, 1000 V, 2500 V and 5000 V
- Battery powered
- START/HOLD button

Typical applications:
- power cables
- distribution transformers
- measuring transducers in distribution networks
- motors and generators
- railway electric systems, etc.

Voltage resistance diagram

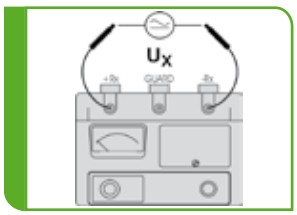


Measurement of Insulation Resistance



Measurement of insulation resistance is mostly carried out without using the GUARD terminal. If you want to eliminate the influence of the surface insulation currents that appear either due to humidity in the atmosphere or because of dirt, the terminal GUARD should be used as shown in the figure.

Measurement and DC or AC voltage



The instrument indicates the value of DC voltage or RMS AC voltage (50 Hz) without releasing the START key.

Ordering information

Standard set **MA 2060**

Instrument ISOtest
Test lead, 2 m (black)
Test lead, 2 m (red)
Test lead, banana/alligator, 2 m (black)
Alligator clips, 2 pcs (black)
Instruction manual
Product verification data

Technical Specification

Insulation resistance	
Measuring range:	500 kΩ ÷ 500 GΩ
Measuring voltage:	500, 1000, 2500, 5000 V DC
Short circuit measuring current:	approx. 1.3 mA
Scale:	logarithmic, l = 90 mm
Accuracy:	±2 mm
START HOLD system:	included
Discharging of line:	automatic, when START key is not pressed
Voltage	
Measuring range:	0 ÷ 600 V AC/DC
Input resistance:	DC voltage 3 MΩ
Input resistance:	AC voltage 1.35 MΩ
Scale:	linear, l = 90 mm
Accuracy:	±2 % of full scale

General	
Power supply-batteries:	4 × 1.5 V DC IEC R20
LOW BAT indicator:	red LED
Dimensions (w × h × d):	345 × 130 × 250 mm
Case:	robust, plastic
Working temp. range:	0 ÷ 40 °C
Nominal temp. range:	10 ÷ 30 °C
Weight:	4.5 kg

Comparison table

Instruments	TeraOhm 10 kV	TeraOhm 5 kV Plus	TeraOhm 5 kV	GigaOhm 5 kV	ISO test
Ordering No.:	**MI 3200**	**MI 3201**	**MI 2077**	**MI 3202**	**MA 2060**
Main features					
Test voltage range	500 V ÷ 10 kV	250 V ÷ 5 kV	250 V ÷ 5 kV	250 V ÷ 5 kV	250 V ÷ 5 kV
Step 25 V / Step 50 V / Preset	• / – / –	• / – / –	– / • / –	– / – / •	– / – / •
Insulation resistance range	10 TΩ	10 TΩ	5 TΩ	1 TΩ	500 GΩ
Graph insulation resistance R(t)		•			
Voltage range	0 ÷ 600 V, AC/DC	0 ÷ 600 V, AC/DC	0 ÷ 600 V, AC/DC	0 ÷ 600 V, AC/DC	0 ÷ 600 V, AC/DC
Timer	•	•	•		
Capacitance measurement	•	•	•		
Diagnostics tests (PI, DAR, DD)	•	•	•		
Step voltage	•	•	•		
DC withstanding test	•	•	•		

Optional Accessories

Photo	Order No.	Instrument / Accessories decription	MI 3200	MI 3201	MI 2077	MI 3202	MA 2060
	A 1046	6 x 1.2 V NiMH batteries, C type		•	•	•	
	A 1288	6 x 1.2 V NiMH batteries, D type	•				
	A 1056	PC SW TeraLink with RS232 cable			•		
	A 1105	Calibration unit					•
	A 1171	USB/RS232 converter with 1 m fixed cable			•		
	A 1230	PC SW TeraLink with USB and RS232 cable	•				
	A 1275	PC SW TeraLink PRO with USB and RS232 cable		•			
	S 2003	High voltage cable set					•
	S 2029	10 kV shielded test lead 8 m	•	•		•	
	S 2030	10 kV shielded test lead 15 m	•	•		•	
	S 2036	10 kV alligator set	•	•	•	•	
	S 2039	5 kV shielded test lead 8 m			•		
	S 2042	5 kV shielded test lead 10 m			•		

Short Glossary

PI - Polarization Index is a ratio using the insulation readings at the one-minute and 10-minute marks. This ratio could be trended or compared to a simple table that would provide an indication of the condition of insulation system.

DAR - Dielectric absorption ratio is a similar measurement to the PI. The ratio of two insulation resistances values that are taken at 15 seconds and 1 minute time slots.

IR - Insulation resistance of insulator, IEV 151-15-43: resistance under specified conditions between two conductive elements, separated by insulating materials.

DD - Dielectric discharge test is a good indication of a level of humidity and dirt or even micro-cracks present in the insulation system.

Step voltage test involves insulation resistance measurement at different test voltages. Good insulation will show very little deviation between particular readings. In case of micro-cracks, dirt or humidity in insulation system the insulation resistance decreases with rising test voltage. When performing a step voltage test, it is important to start with the lowest test voltage and then move to a higher voltage level. Typical test duration is 60 seconds.

Withstanding voltage The voltage applied to insulator which has to be kept without a breakdown.

Guard Use of a guard terminal eliminates an influence of surface insulation currents on the measuring result and leads the surface current away from the main measuring circuit. Guard terminal is to be used in conjunction with shielded test leads when measuring insulation resistances in GΩ and TΩ range.

Leakage AC or DC that flows trough or on the insulation's surface.

Note! Photographs in this catalogue may slightly differ from the instruments at the time of delivery.
Subject to technical change without notice.

METREL®
Measuring and Regulation Equipment Manufacturer
METREL d.d.
Ljubljanska 77
SI-1354 Horjul
Tel: + 386 (0)1 75 58 200
Fax: + 386 (0)1 75 49 226
E-mail: metrel@metrel.si
http://www.metrel.si

2008/oktober/ang.j./D.Dolinar/Kočevski tisk